GRAVITY GRADIENT STABILIZATION SYSTEM for the APPLICATIONS TECHNOLOGY SATELLITE

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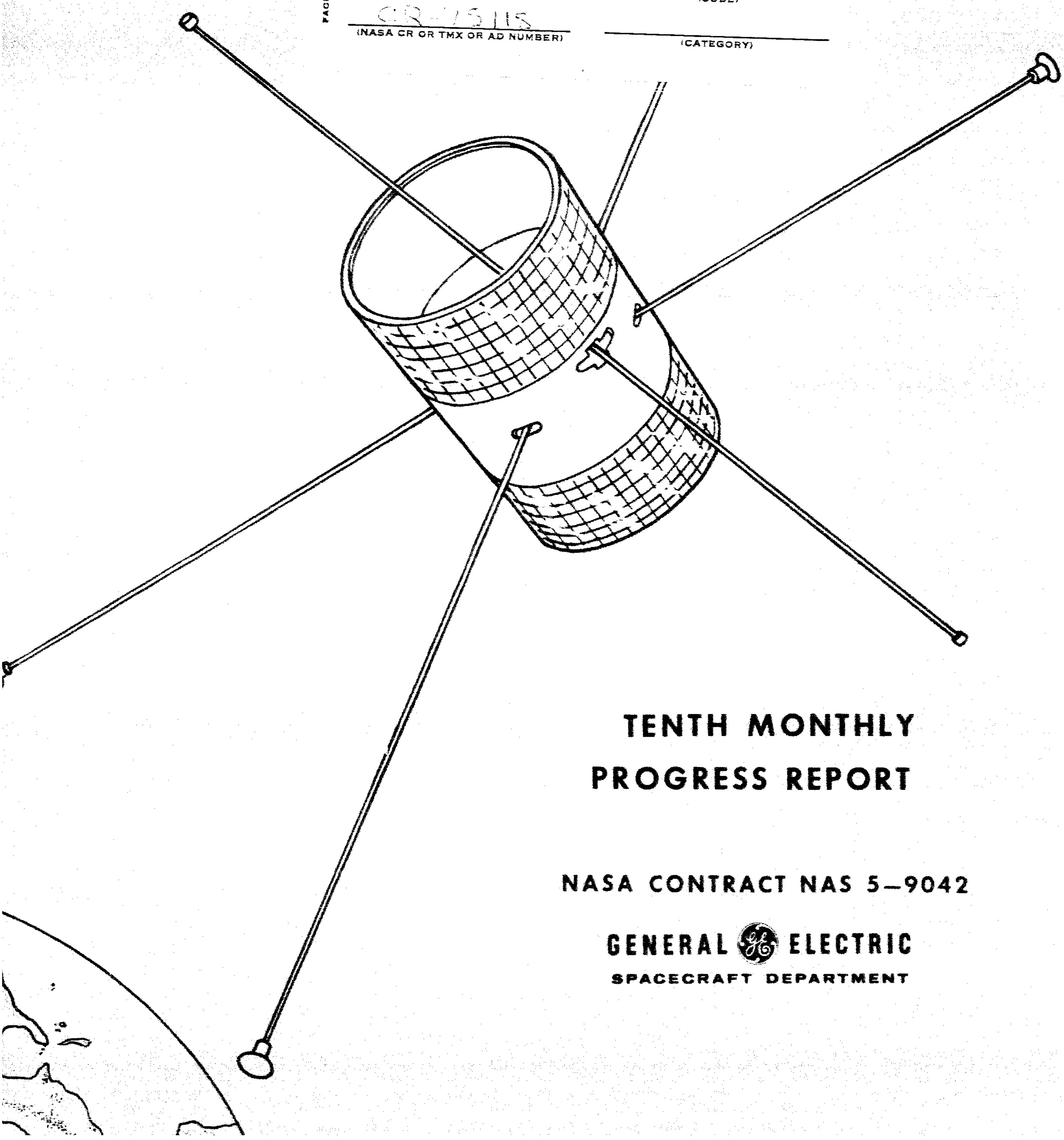

TENTH MONTHLY PROGRESS REPORT

NASA CONTRACT NAS 5–9042

GENERAL ELECTRIC
SPACECRAFT DEPARTMENT

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GRAVITY GRADIENT STABILIZATION SYSTEM
FOR THE
APPLICATIONS TECHNOLOGY SATELLITE
TENTH MONTHLY PROGRESS REPORT

1 APRIL THROUGH 30 APRIL 1965

CONTRACT NO. NAS 5-9042

FOR THE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Approved By: R. J. Katucki, Manager
Passive Attitude Control Programs

GENERAL ELECTRIC

SPACECRAFT DEPARTMENT

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SECTION 1

INTRODUCTION

1.1 PURPOSE

This report documents the Tenth Month of progress toward the design of the ATS Gravity Gradient Stabilization System. The report covers the period from April 1 to April 30, 1965.

1.2 SCOPE

Under Contract NAS 5-9042, the Spacecraft Department of the General Electric Company has contracted to provide Gravity Gradient Stabilization Systems for three Applications Technology Satellites: one to be orbited at 6000 nautical miles and two to be orbited at synchronous altitude. The gravity gradient stabilization systems will consist of the stabilizing boom and dampers, attitude sensors, and power control and interface electronics.

SECTION 2

SYSTEMS ANALYSIS AND INTEGRATION

Systems analysis efforts during April were concerned primarily with definitization of the new spacecraft configuration parameters, re-evaluation of capture and inversion dynamics, preliminary investigations of hysteresis damper parameters, and continued efforts on the Attitude Determination Program, Flight Evaluation Plan and ATS Mathematical Model.

Capture studies are now based on an initial 90-degree yaw maneuver with the Agena prior to separation; initial spacecraft pitch rate tolerances have been increased to ±0.40 degree per second (from the ±0.25 degrees per second used in previous studies) relative to orbital pitch rate. These changes are based on decisions made at the ATS Trajectory Meeting, Lunis Research Center, on 21 April 1965. The study is still in progress.

An analysis of launch constraints (based on the HAC "Shadow Time Prediction Nomagram," p. 2-7, HAC Quarterly Progress Report No. 2) indicates only two periods during 1967 that satisfy both HAC and GE requirements:

1. March 10 to 27, 1967
2. September 10 to 25, 1967

The HAC constraint is basic to the spacecraft power supply design and must be satisfied. (The sun vector must fall within 25 degrees of the orbit plane for the useful life of the satellite). The GE constraint (that an initial 3-4 week period of continuous sunlight be provided) is crucial to good experiment design and data interpretation but is not mandatory for successful spacecraft operation. Launch during any other period of the year (other than the March or September dates) will compromise the GE data requirements. Specific details of these tradeoffs are contained in ATS Systems Memo No. 041, transmitted to NASA/GSFC on 30 April 1965.

Inversion studies have been expanded to include consideration of techniques for relaxing thrust tolerances on the subliming rocket inversion motors. If inversion is to be accomplished strictly on the basis of a pre-determined on-off burn time cycle, tolerances on thrust levels must be held to the previously specified $\pm 10\%$ values (about the nominal torque level of 7×10^{-4} lb-ft). However, if attitude data can be provided on a real-time basis, time of on-off commands can be optimized as a part of the operational inversion procedure. Application of real-time data from the solar aspect sensor seems feasible and is under current investigation. Preliminary results indicate tolerances on thrust levels may be relaxed to as much as $\pm 43\%$. However, this does not consider limitations on time of inversion. (The entire inversion maneuver must be within range of ground station coverage to get the required telemetry data and maintain the required command capability). Inclusion of limits on total time for inversion may reduce these tolerances somewhat. Studies are still in progress.

The orbit test plan published in the Third Quarterly Report has been revised as follows:

1. X-boom deployment will be at a nominal half-angle of 19 degrees to avoid major redesign of the deployment mechanism; booms will be scissored to the nominal operating half-angle of about 25 degrees after completion of the deployment and capture sequence and after deployment of the damper booms and uncaging of the combination passive damper. The resultant transient will increase the time required in test No. 3 by approximately 3 days.

2. Inversion will be accomplished at the fully-extended boom length of 133.3 feet; this increases the nominal time for inversion from 2.5 hours to 3.8 hours but reduces total test time from 6 days to 3 days. This change was made to eliminate boom retraction as a necessary condition for inversion; boom retraction will be performed as an isolated test (Tests 11-12).

A preliminary evaluation of hysteresis damping (using GE's preliminary GAPS III hysteresis damper model) was conducted. The saturation torque level specified by NASA/GSFC (27.1 dyne-cm) was used for ATS-A and a scaled value (4.5 dyne-cm) was used for ATS-D/E. Large amplitude motion initial conditions utilized were identical to those for previous runs using eddy current damping. The results, as steady state conditions are approached, are sensitive to the hysteresis damping model utilized, and they serve to underscore the need for early hysteresis torque data to improve on the mathematical model of the hysteresis damper. ATS-A had not reached steady state after 150 hours; the damper boom oscillations reached 48 degrees. (This compares with 80 hours to steady state using the eddy current damping model). ATS-D/E was still tumbling after 400 hours. (Tumbling stopped after 300 hours with eddy current damping). The original GSFC configuration (with eddy current damping) stopped tumbling at 150 hours and reached steady state in 300 hours; for ATS-A, steady state conditions were achieved in 60 hours. The initial conditions imposed on ATS-D/E were severe and may represent a worst case. Additional runs at increased saturation torque levels (50 dyne-cm for ATS-A and 10 dyne-cm for ATS-D/E) were made. ATS-A damped to approximately 8 degrees in 150 hours; ATS-D/E runs are not complete. Studies are continuing.

An analysis of TV data requirements has re-affirmed the necessity for a 2 to 3 inch resolution in accuracy of boom target coordinates determination. If data resolution fails to meet these requirements, the engineering validity of the resultant data (in terms of evaluation of boom thermal bending and boom dynamics phenomena) is questionable.

SECTION 3

BOOM SUBSYSTEM

3.1 DEPLOYMENT

It was planned to extend and retract each of the primary boom rods by pulsing the extension/retraction motor with a voltage ramp function supplied from the Power Control Unit. However, the motor speed control was one of the circuits eliminated as a result of the PCU weight reduction program. A plan is under investigation to reduce the velocity of primary boom movements (extension/retraction) to 1 foot/second, instead of the former 3 feet/second, to provide an even greater margin of safety against the possibility of rod buckling. The speed reduction can be accomplished by changing the ratio of the final two gears in the sealed drive assembly.

3.2 STRUCTURE

Hughes Aircraft has recommended that the scissoring mechanism and the associated two primary rods (one half of a primary boom system) be mounted to the ATS vehicle on a three-hole configuration which they will furnish. A preliminary structural analysis has indicated that the plan is feasible. Further study will be conducted to investigate the integrity of the primary boom packages when mounted in this configuration.

3.3 TIP TARGETS

The drawing of the tip target (TV target) has been completed. Each target is defined as 9 inches in diameter with a tolerance of +.050, -0 inch. The base material of the targets is 1/16-inch aluminum. The material for the optical surface was defined. The specification for the tip target is in preparation. Shroud clearance problems may cause slight target reconfiguration. The target will be pivoted to erect normal to the X-boom centerline.

3.4 TEST EQUIPMENT STATUS

3.4.1 TEST TRACK

The test track, to be used for boom deployment testing, was inspected at the vendor's facility. It is anticipated that installation of the test track will begin at GE during the week of May 3rd.

3.4.2 TEST CONSOLE

Design of the Boom Subsystem Electronics Test Console has been completed. Parts procurement will begin during the week of May 3rd.

3.4.3 TEST TROLLEY

Trolleys have been completed by deHavilland. The test trolley functions will be tested as soon as Engineering Units of the Booms have been completed. When initial testing of the trolleys is completed by deHavilland, they will be shipped to GE for installation on the test track.

3.4.4 TAKE-UP MECHANISM

The design of the Take-up Mechanism has been completed by deHavilland. GE Quality Control Equipment Engineering is presently reviewing the design.

3.5 SPECIFICATION AND WORK STATEMENT

The Boom Subsystem Specification, SVS-7316, and the related work statement have been revised to clarify:

1. Scissoring capability
2. Temperature sensor locations
3. Tip Target definitions
4. R-F experiment.

SECTION 4

COMBINATION PASSIVE DAMPER (CPD)

4.1 SUMMARY

Major events for the month include:

1. Space Technology Lab (STL) personnel at GE on 2 April 1965 for negotiations relative to the passive hysteresis damper.

2. On 5 April, agreement on the caging mechanism design was reached with NASA at a meeting at Goddard.

3. STL was authorized by TWX (8 April 1965) to proceed on the passive hysteresis damper design.

4. A design summary presentation was made to NASA management personnel at GE on 14 April. The CPD design and test status were discussed during the meeting.

5. GE personnel visited STL and HAC 27-29 April to discuss mutual interface and engineering problems. A Quality Control Survey was made of the STL facility.

4.2 DESIGN EFFORT

4.2.1 CONFIGURATION STATUS

At the beginning of the reporting period, several problems were outstanding which presented major obstacles to the continuation of the design effort on the CPD. These problem areas included:

1. Caging mechanism design agreement with NASA.

2. Extended boom shaft and other changes incurred as a result of interface problems with the new HAC vehicle.

3. The digital angle detector required a larger disc diameter than the previous analogue (DRC) design, thus necessitating relocation within the CPD package and accompanying rearrangement of adjacent items.

4. Adequate clearances to the envelope of the STL furnished passive hysteresis damper as a result of the desired changes within the CPD package had to be checked and resolved.

At the end of the reporting period, the above problems had been resolved to the extent that detail design was proceeding on several parts of the CPD assembly.

4.2.1.1 Caging Mechanism

A number of different caging conceptual layouts were generated to compare with the tapered pin design. The various approaches to caging the boom shaft and the eddy current damper included various pin concepts, ("Marman clamp" concepts, vee block concepts, and variations of each). The basic problem in all the above approaches was to cage both the boom shaft and the eddy current damper with a single mechanism thus minimizing space, weight, and the number of pyrotechnic devices required. The "Marman clamp" approach could be used to cage either the boom shaft or the ECD, but no scheme to cage both with a single clamp could be devised because of geometry problems inherent in the CPD concept.

At a meeting at NASA Goddard on 5 April, it was agreed to proceed with the tapered pin design since it appeared to be the simplest approach, required the minimum space and weight, and would probably be the most reliable of the schemes considered. This design was accepted by NASA on the following conditions:

1. Sufficient tests be run with a manually actuated model to provide assurance of a reliability of .995 (approximately 300 operations with no failure). NASA requested that some of the tests be "free fall."

2. That if there were a failure attributable to the basic design concept, a relatively extensive redesign would be expected in lieu of a simple "fix."

4.2.1.2 CPD/Vehicle Interface

At a meeting with HAC representatives at NASA Goddard on 5 April, the following general agreements were reached:

1. GE would make the CPD structurally adequate with no inboard attach points to the vehicle; however, a thermal conduction path would be required to the vehicle in the area of the deleted attach points.

2. GE iterated its preference that thermal heaters not be used in the CPD and HAC was requested to allow for a 1-1/2-watt heat loss and a 3 watt input to their thermally controlled compartment.

3. HAC would furnish insulation over the exposed portion of the damper except in the area between the damper boom and the CPD baseplate which GE would furnish.

GE Interface Drawing 47D207098 of the CPD was forwarded to NASA the 7 April 1965. At NASA's request, two copies of this drawing were sent directly to HAC on 8 April.

At a meeting at HAC on 28 April, HAC requested that the mounting arrangement of the CPD be changed from four pads with radial attach holes to four lugs with longitudinal attach holes on a 13-inch diameter bolt circle. GE agreed to incorporate this change on the CPD design. GE reiterated their requirement for thermal transfer capability to vehicle structure in lieu of heaters. HAC was still operating under the assumption that the CPD was thermally isolated from the vehicle and did not desire to provide thermal transfer capability. This point must be clarified by NASA before final interface agreement can be reached.

4.2.1.3 Angle Detector

The in-house design effort on the digital-type angle detector is progressing satisfactorily. Samples of detectors and lamps were procured and several preliminary tests have been run for evaluation. A sample encoder disc was fabricated in-house, but was not entirely satisfactory chiefly because it was made of readily available material which was of neither the proper thickness nor temper. Several potential encoder disc vendors have been contacted and quotes are being received and evaluated. Fiber optic suppliers have also been asked to quote. Lamp suppliers have been requested to supply reliability data on all proposed lamps including 5 volt, 28 volt, and gallium arsenide light sources. A weight reduction program on the Power Control Unit (PCU) required a comparative study on the weight trade-offs between the use of 5-volt lamps with power conversion, and the use of 28-volt lamps without power conversion. A decision to use 5-volt lamps for reliability reasons has been made, and the design is proceeding based on this decision.

4.2.1.4 Development Tests

Torsional restraint tests for the eddy current damper (ECD) were run with the final cylindrical torsional restraint configuration using "diamond" shaped ferromagnetic material in lieu of the "crescent" shape previously tested. There are indications that there may be a problem with linearity. This is being investigated further. Several materials have been tested in an effort to reduce lateral forces in the ECD torsional restraint. Sound tape A303 (Eastman Kodak Co.) appears to have the best (lowest) lateral force characteristics, but linearity is slightly poorer than with stainless steel material.

The diamagnetic suspension design equations have been programmed for digital computer solution. Variations in the several design parameters can now be rapidly evaluated. The external loads which must be supported by the diamagnetic suspension system were respecified by the Systems Analysis Operation at GE. These new loads and cocking torques and their effect on the number of suspension magnets required were evaluated by the use of the computer program. After an extensive analysis, which considered not only the reduced loads and cocking torques, but also the torsional restraint lateral force ranges and other variables that have an effect on suspension forces, two suspension rings of 10 magnets each have been selected as the optimum arrangement for the diamagnetic suspension.

4.3 SUBCONTRACT ACTIVITIES

4.3.1 PASSIVE HYSTERESIS DAMPER (PHD)

A final negotiation meeting was held at GE with STL on 2 April. At this meeting, several changes to the PHD envelope drawing (GE 47D207083) were agreed to and the drawing was officially released 7 April. In addition, several changes to the Work Statement 4176-WS-008 and potential changes to Specification SVS-7331 were discussed and agreed on. Go-ahead approval was given to STL on 8 April.

On 27 and 28 April, GE personnel visited STL to discuss engineering problems and to clarify the testing sequence and details of testing. Several problems related to decaging during tests were discovered. Since STL is enclosing the PHD with a cover for shielding purposes, it appears that it will be necessary to remove the PHD from the CPD to gain access for rearming the PHD decaging pyrotechnic devices after every test firing. Efforts are being made to resolve this problem. Other minor design questions and problems were discussed at the meeting. A design review will be held at GE during first week of May.

A Quality System Survey was made of the STL facility during this trip; their QC system was found to be excellent.

4.3.2 SOLENOID

Arrangements have been made to purchase two solenoids from the G. W. Lisk Company to GE Specification R4606, with an exception relative to force requirements. These solenoids will provide engineering with information relative to the force vs. travel characteristics that can be obtained from a solenoid of the required size. These characteristics are very marginal according to calculations, and results of tests on these solenoids will provide Engineering with information to finalize the actual solenoid design.

4.4 TEST EQUIPMENT

4.4.1 AIR BEARINGS FOR LOFF AND ADTF

Both air bearings have been received and acceptance tests completed. The ADTF (Advanced Damping Test Fixture) air bearing has been installed and complete calibration, including that for the torquer pick-off, are in the final stage. The LOFF (Low Order Force Fixture) air bearing calibrations are also in the final stages. Both the ADTF (Figure 1) and the LOFF (Figure 2) are expected to be available for use during the first week in May.

4.4.2 BOOM SHAFT AND ECD CAGING MECHANISM MODEL

A caging mechanism model (Figure 3) was fabricated for demonstration at the Design Status Presentation to NASA Management on 14 April. This model incorporates the tapered pin concept and contains all the design features of the actual caging mechanism as presently planned. The model is manually cocked and released. Reliability testing required by NASA is planned to be performed using this model.

4.4.3 LOAD-DISPLACEMENT TEST JIG

A load-displacement test jig (Figure 4) was constructed for evaluating the travel versus force requirements of the diaphragm clutch. It is anticipated the fixture will also have application for measuring solenoid performance.

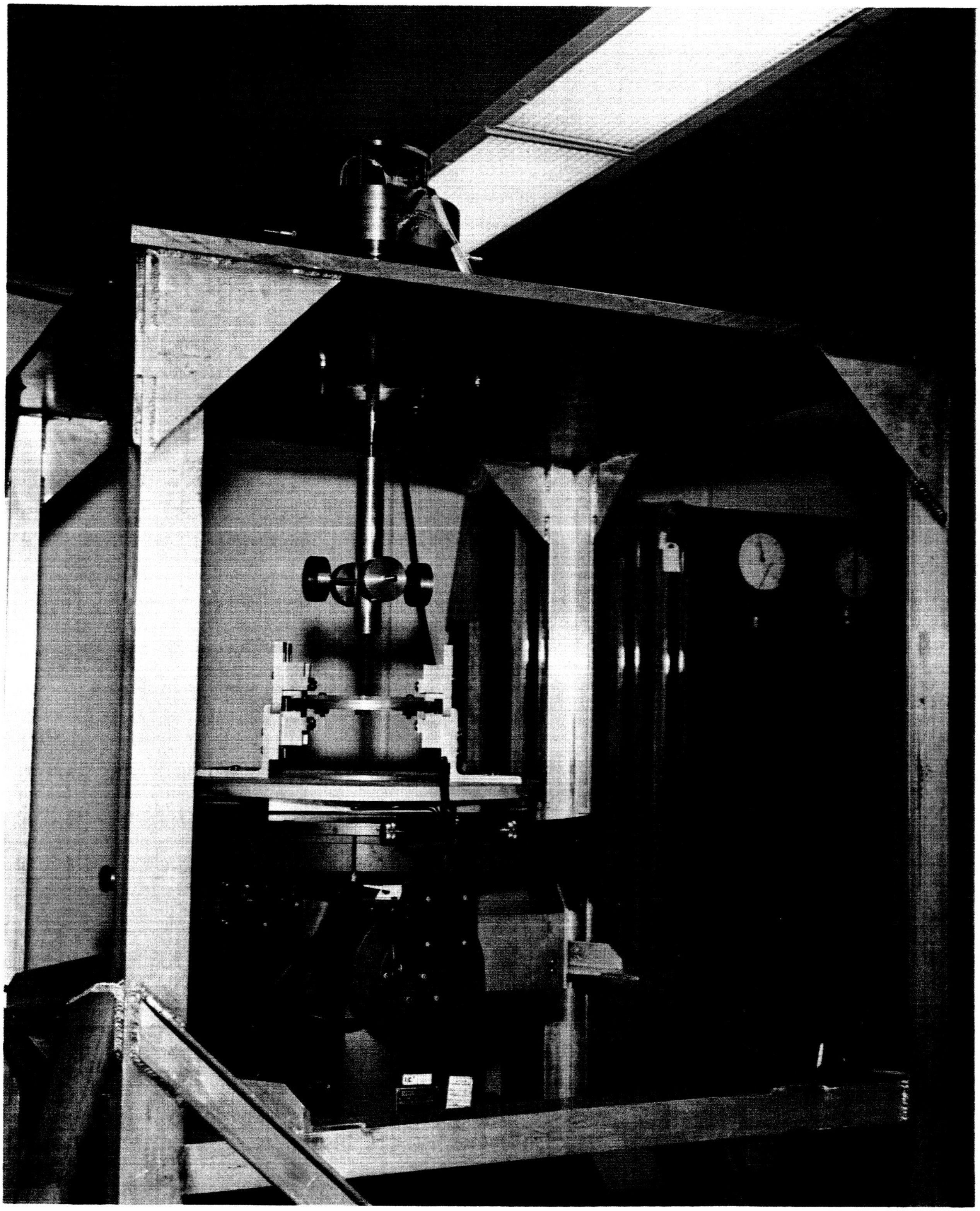


Figure 1. Advanced Damping Test Fixture (ADTF)

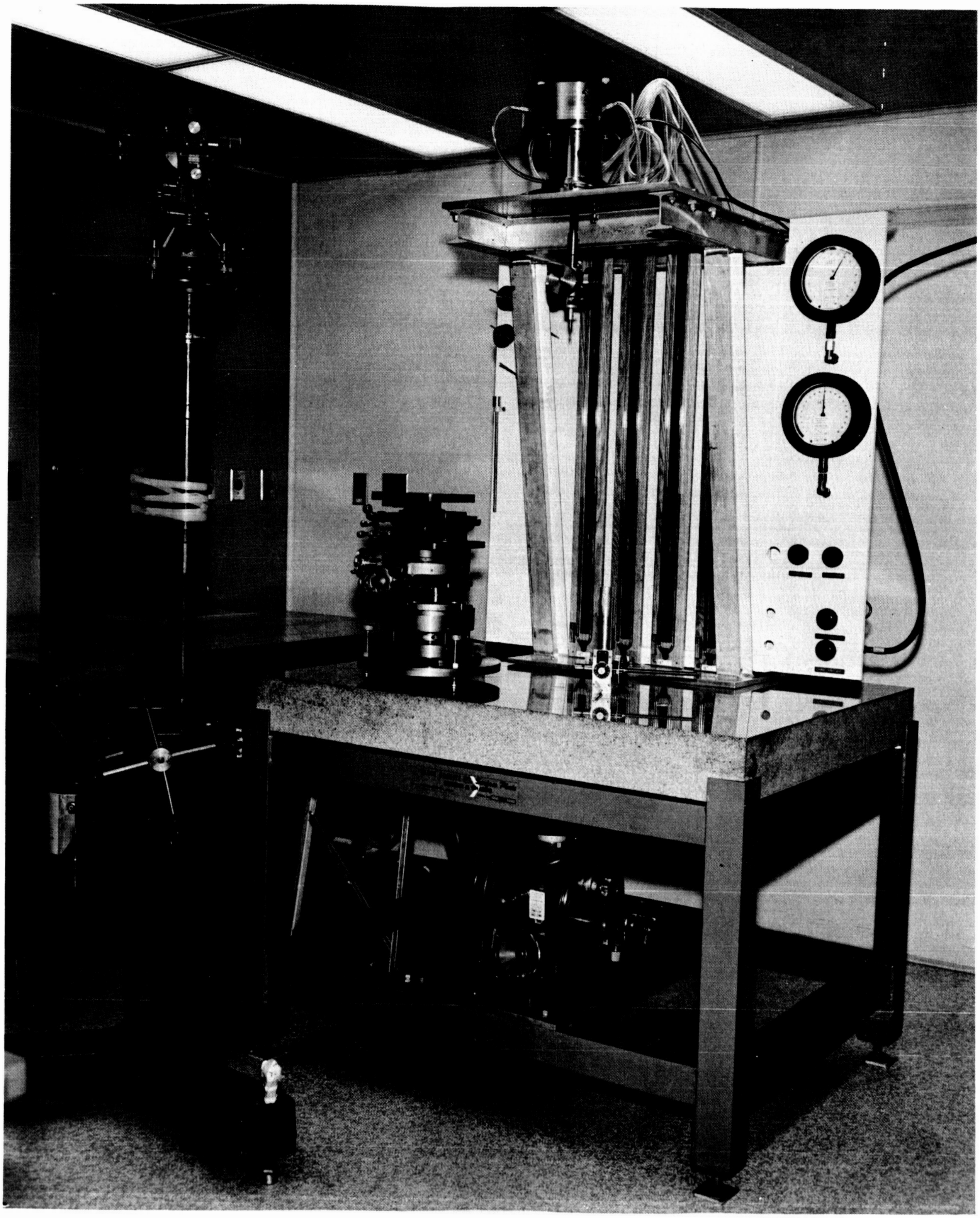
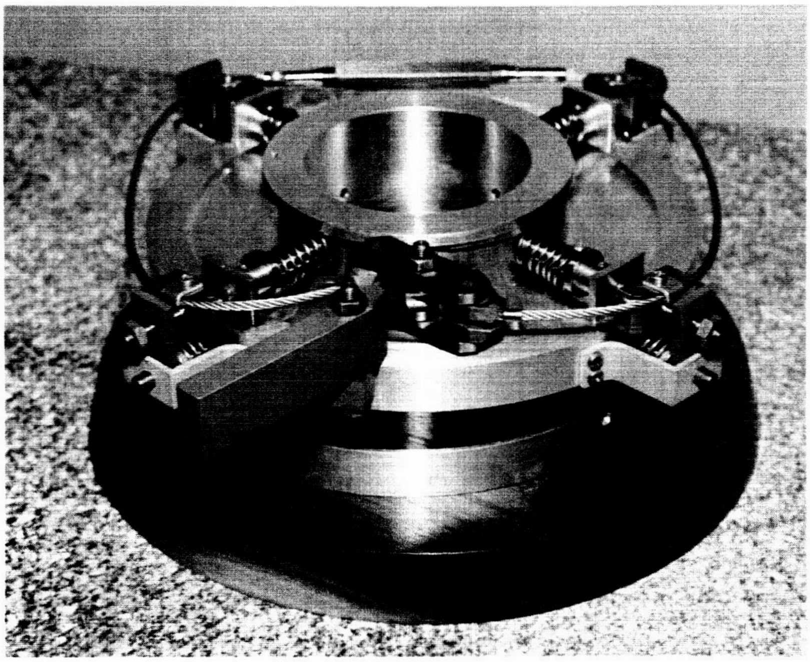


Figure 2. Low Order Force Fixture (LOFF)

(A) Cocked Position



(B) Released Position

Figure 3. Tapered Pin Caging Mechanism

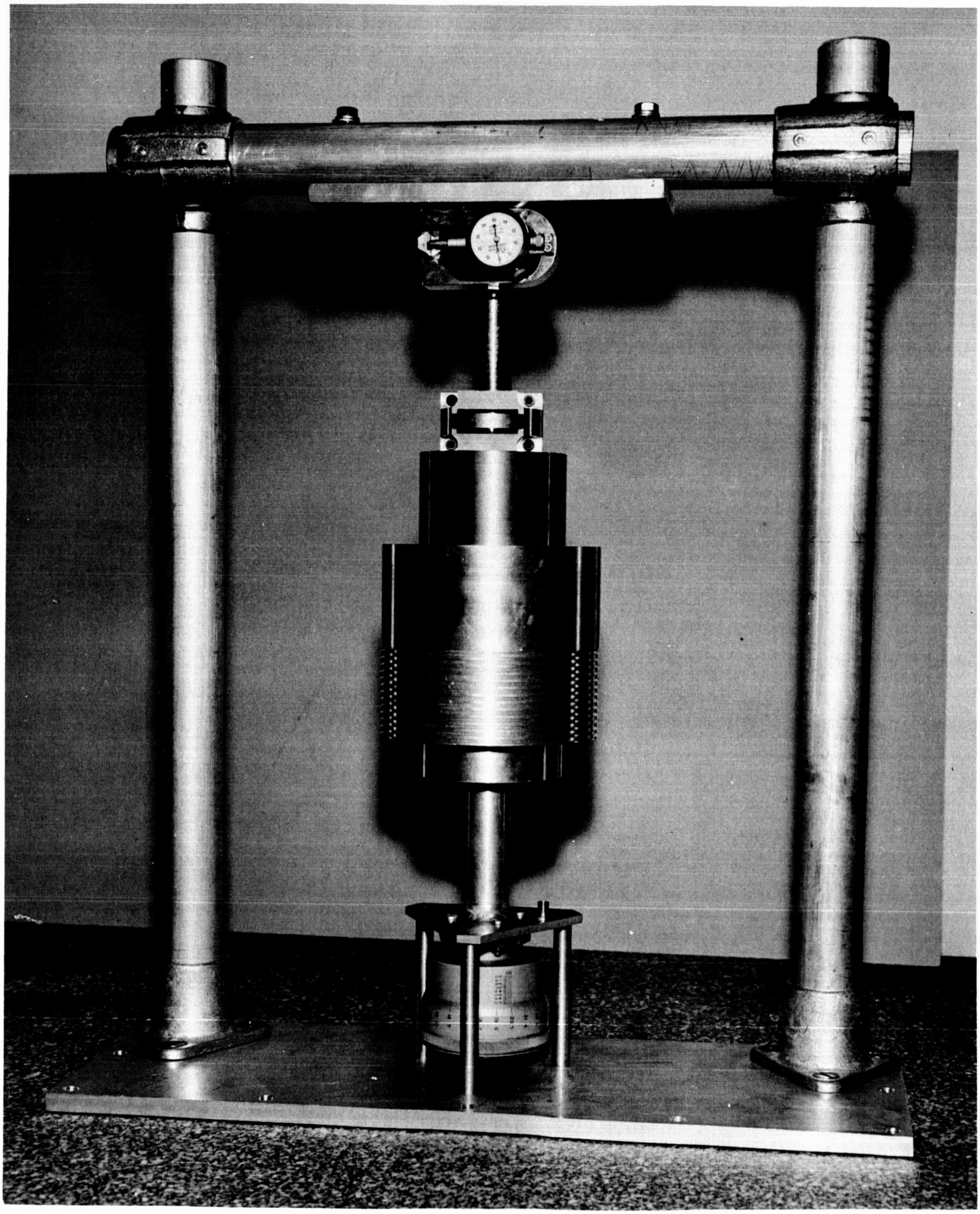


Figure 4. Load Displacement Test Jig

SECTION 5

ATTITUDE SENSOR SUBSYSTEM

5.1 SOLAR ASPECT SENSOR

The Adcole Corporation has continued effort toward the fabrication of the developmental model of the Solar Aspect Sensor under direction of GE Engineering. Source control drawings were released for the electronics unit and detector assembly. These drawings establish the physical dimensions and interface mounting data for the electronics package and detector. GE Engineering Standards reviewed the Adcole specifications for solar cells and transformers, and their specifications for the tape cable was approved for use between printed circuit boards.

The outline drawing of the Solar Aspect Sensor and the approved parts list were reviewed with Adcole. Definitions were established for testing activities. Adcole's general test plan was reviewed and approved by GE. They have agreed to an extensive testing program which they are to conduct at their facility, but under General Electric surveillance.

5.2 TV CAMERA

Contract negotiations continued with Lear-Siegler of their Model 0431C Camera, modified to include the functional requirements of the TV Camera functions. The controlling component specification (SVS-7310, Rev. C) and the Work Statement (9744-WS-001, Rev. C) were revised to reflect the changes that were agreed between Lear-Siegler and GE. The outline drawings (47-207010 and 47-207011) were revised to include the new maximum dimensions of the lens and shutter assembly.

The overall length of the TV Camera allows only .87 inch clearance between the back of the Camera and the vehicle thrust tube, assuming the front of the lens is flush with the spacecraft skin. It is doubtful that a 28-pin connector can be accommodated, even if it were mounted at right angle. In addition, the lens and shutter subcontractors (Wollensak) has recommended that the lens be recessed inside the spacecraft and view the booms and target through a quartz window mounted on the skin of the vehicle to aid thermal protection. This method of mounting the quartz window is unacceptable because it would complicate the problem of mounting the TV camera in the spacecraft. Wollensak has been requested to incorporate the quartz thermal protection as the first element in the camera lens.

Final negotiations were completed on April 23rd between GE and Lear-Siegler for fabrication and test of the TV Camera system.

A test was made of the effect on the TV picture when the video output of two TV cameras were connected together. The presence of the 3.5 mc/s filter introduced standing waves in the picture as evidenced by a shift of the scene and the introduction of "TV ghost" images. Two arrangements were tried during the test; the first was a simple connection of the two video lines at the output of the filter, the second connection attempted to maintain a 3-way impedance match of 75 ohms. Neither arrangement was satisfactory. Additional tests will be made connecting the video outputs of two cameras in parallel ahead of a single filter.

5.3 POWER CONTROL UNIT

A breadboard of the boom extension motor speed control circuit was completed and incorporated into the remainder of the component breadboard of the PCU. The wiring modifications required in the primary boom assemblies to reduce the number of circuits were discussed with deHavilland.

The PCU breadboard was demonstrated to NASA/GSFC at the ATS design review which was held at GE on April 14th. Included in the demonstration were the motor armature current sensors, the acceleration/deceleration control of the extension motors, the squib firing delay circuit and the operation of the video alternator.

An informal review of the PCU design was conducted with personnel from NASA/GSFC on April 13th with the result that GE was directed to reduce the weight of the PCU to approximately 10 pounds from an estimated 17 pounds. An evaluation was made to determine which operational functions might be eliminated as a result of the weight reduction program. The following functions were eliminated from the Power Control Unit:

1. Motor speed control
2. Separation timer and automatic boom stop
3. Squib driver redundancy
4. Current sensors and a-c power supply
5. Temperature sensor bridge resistors
6. Video alternator and video relay
7. Damper solenoid regulator power supply.

With elimination of the circuitry representing these functions, using a magnesium structure in place of aluminum, and a lighter weight commercial potting compound; the estimate of the revised weight was 11.5 pounds. However, NASA requested that the PCU structure be made of aluminum instead of magnesium, and they have allocated an increase in total weight to 10.5 pounds to accommodate the extra weight of the material.

Since weight is not a critical problem in the ATS-A system, it was suggested that those functions required for only ATS-A (e.g., control circuits for TV camera system No. 2 and the IR Earth Sensor No. 2) be incorporated in a separate package which could be eliminated for ATS-D/E. This approach would permit the incorporation of some highly desirable functions on ATS-A (e.g., the squib-driven redundancy, motor current sensors, separation timer, and the video relay, if analysis indicates the 3 db loss from the impedance matching pad between the output of the two cameras is not acceptable).

Subsequent packaging design of the PCU to the reduced weight requirements was begun with the result that the revised circuits were housed in a package approximately 8-1/2 by 9-3/4 by 6-3/4 inches. No problem was foreseen in mounting the PCU package in the spacecraft. However, the external dimensions will not be fixed until the new preliminary circuit boards are completed early in May. This hold will ensure that all of the remaining functions can be incorporated into the new PCU envelope. The electrical interface connectors are being redefined to take advantage of the new internal configuration.

The component breadboard of the PCU and engineering tests were modified in line with the new functional requirements. The remaining functions of the Power Control Unit are as follows:

1. Power Switching to:

   a. TV Camera subsystem
   b. Solar aspect sensor and angle indicator
   c. IR earth sensor
   d. Angle indicator redundant lamps
   e. Extension and scissor motors.

2. Squib firing to:

   a. Damper booms
   b. Eddy current damper and damper boom shaft
   c. Hysteresis damper.

3. Solenoid switching to:

   a. damper clutch
   b. Primary boom assembly A clutch
   c. Primary boom assembly B clutch.

4. Telemetry synchronization pulse to SAS.
5. Emergency power reset.
6. Ground return distribution.
7. Telemetry analog signal paralleling.

8. Event channel D to A networks (4).
9. Digital monitor paralleling and isolation.
10. Power supply for damper angle indicator lamps.
11. Telemetry reference voltage power supply.
12. Telemetry voltage monitor.

SECTION 6
QUALITY CONTROL

6.1 BOOM SUBSYSTEM

A trip was made to deHavilland by GE Quality Control personnel to review the design and construction of the test trolley that will be used in conjunction with the test track for primary boom deployment testing. Other topics that were covered during the visit include: application of NPC 200-3 to deHavilland subcontractors, review of the bolt cutter requirements and a review of progress on the thermal and dynamic models. An in-process inspection of the test track was performed.

6.2 COMBINATION PASSIVE DAMPER

The STL proposal for fabrication and test of the passive hysteresis damper was reviewed for compliance with NASA and GE quality control provisions. Agreement was reached during negotiations for all QC provisions.

A "Vendor Quality Control Capability Survey" was performed on a potential subcontractor of the solenoid. The vendor did not meet the quality control requirements. GE requested a schedule of compliance before proceeding with negotiations.

6.3 ATTITUDE SENSOR SUBSYSTEM

The QC portions of the Lear-Siegler proposal for the TV camera were negotiated. The QC requirements of GE Standing Instruction SI 217260 and NPC 200-3 were accepted as defined in the work statement for the TV camera system.

6.4 SOLAR ASPECT SENSOR

A trip was made to the Adcole Corporation by GE Quality Control personnel for discussions of the SAS program status, their proposed testing, and potential problem areas. A possible materials problem was identified in the coating used to provide the slit on the sensor. Confirming tests have been initiated to isolate the details of this problem. See paragraph 6.6. Detailed requirements for the wood mock-up thermal model, and dynamic model were reviewed and changes were made to the work statement as a result of discussions.

6.5 PARTS

A color code system has been defined. The system will be used to identify piece parts that have passed the requirements for incorporation into the engineering unit, the prototype or flight equipment. Basic quality control requirements have been established for parts specifications. These requirements will be made a part of the applicable component specifications for GGSS equipment.

6.6 MATERIALS AND PROCESSES

A test procedure was begun to determine the effect of ultraviolet on the sun sensor reticle in a vacuum environment and under varying temperature conditions. The objective of this test will be to uncover possible spalling of the coating material that determines the slit.

In preparation for meteoric particle testing of gravity gradient rods, the source facility in the Space Sciences Laboratory at GE was calibrated with respect to particle size distribution. One liner fired into paraffin showed a median particle size of about three microns, a closer match to the anticipated orbital values than originally expected.

A test will be conducted to determine the temperature distribution of a gravity gradient rod when illuminated with a unidirectional flux in air.

Design of an impact absorber for an actuator used in the CPD has begun.

A motor gearhead to be used to test various lubricants for use in the erection mechanism, has been fixtured and is ready for test.

SECTION 7

RELIABILITY, AND PARTS AND STANDARDS

7.1 RELIABILITY

A review of the GE reliability effort and the Data Exchange Program between the Hughes Aircraft Corporation and GE was held with the NASA/GSFC West Coast Representative. A plan was tentatively established whereby the NASA West Coast Representative will be the liaison to maintain surveillance in the exchange of parts data information between GE and HAC.

The dual (redundant) squib driver circuits were eliminated for all pyrotechnic devices as a result of the weight reduction in the Power Control Unit. An alternate design has been recommended in which the squib driver circuits would be used in a sequence firing configuration, thereby providing a backup for the failure of any one pyrotechnic device required for the release of the Combination Passive Damper components.

The Parts Qualification Program for the Gravity Gradient Stabilization System was redefined to conform with the negotiated program. These provisions are defined in Work Package No. 2210 of the GE Work Statement, document No. 65SD4293.

7.2 PARTS AND STANDARDS

The ATS Parts List (490L106) was reviewed to account for the addition and deletion of parts used by in-house engineering and subcontractors. The Relay Drawing R-2314 was replaced by R-2313.

Consultation services were provided during April to Reliability and Design Engineers, Production Control, Quality Control, and subcontractors for interpretation of parts and standards to these activities.

Three new or revised issues of Hughes Aircraft Corporation parts specifications were received during the month. The changes indicated in these documents will affect approximately 150 GE specifications.

The following cover specifications for parts in the ATS program were reviewed and approved during April:

R-4609	Transistor Cover Spec for SAS
R-4605	Diode Cover Spec for SAS
171A8324	Resistor Spec
8136	SAS Spec

SECTION 8

SPECIFICATION STATUS

The following lists the number and title for each component specification associated with the ATS Gravity Gradient Stabilization System. The Space Vehicle Specification (SVS) number designates the particular document which is recorded and controlled within the GE Spacecraft Department.

Specification No.	Title	Status
SVS-7306	Solar Aspect Sensor-ATS	Revision B - 12/22/65
SVS-7307	Power Control Unit-ATS	Review (Awaiting Comments)
SVS-7310	TV Camera Subsystem-ATS	Revision C - 2/26/65
SVS-7314	Combination Passive Damper	Review
SVS-7315	Angle Detector	This specification has been cancelled. The requirements for the boom angle indicator have been incorporated into the CPD Specification, SVS-7314.
SVS-7316	Boom Subsystem	Revision C - 4/28/65
SVS-7325	Standard Parts, Materials and Processes, Use of	Revision C - 12/31/64
SVS-7331	Passive Hysteresis Damper	2/23/65
SVS-7338	Standards, Engineering Equipments	Revision A - 4/2/65

SECTION 9

SCHEDULE

The schedule for the hardware items which will be delivered for use by the spacecraft contractor is shown in Table 1. The schedule is a summary of the detailed PERT networks which have been established and will be maintained for program control. The schedule is based on the revised program defined in the Work Statement, GE Document 65SD4293 dated April 20, 1965.

TABLE 1. DELIVERY SCHEDULE FOR GRAVITY GRADIENT STABILIZATION SYSTEMS

	1965												1966											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Thermal Model								△																
Dynamic Model									△															
Prototype Unit																△								
Flight Unit No. 1 (ATS-A)																			△		△			
Flight Unit No. 2 (ATS-D)																				△		△	*	
Flight Unit No. 3 (ATS-E)																					△		△	**

△ Estimated Delivery Date

* To Be Retained By G.E. Until Sept. 1, 1967

** To Be Retained By G.E. Until Mar. 1, 1968

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